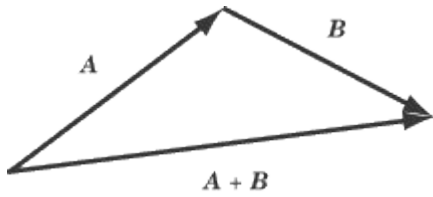


# Vector Addition

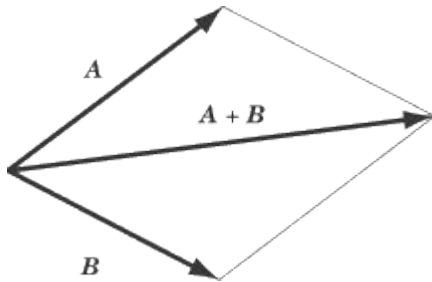
## Tip-to-Tail Method



We can add any two vectors,  $\mathbf{A}$  and  $\mathbf{B}$ , by placing the tail of  $\mathbf{B}$  so that it meets the tip of  $\mathbf{A}$ . The sum,  $\mathbf{A} + \mathbf{B}$ , is the vector from the tail of  $\mathbf{A}$  to the tip of  $\mathbf{B}$ .

*Note that you'll get the same vector if you place the tip of  $\mathbf{B}$  against the tail of  $\mathbf{A}$ . In other words,  $\mathbf{A} + \mathbf{B}$  and  $\mathbf{B} + \mathbf{A}$  are equivalent.*

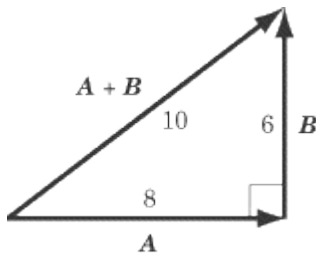
## Parallelogram Method



To add  $\mathbf{A}$  and  $\mathbf{B}$  using the parallelogram method, place the tail of  $\mathbf{B}$  so that it meets the tail of  $\mathbf{A}$ . Take these two vectors to be the first two adjacent sides of a parallelogram, and draw in the remaining two sides. The vector sum,  $\mathbf{A} + \mathbf{B}$ , extends from the tails of  $\mathbf{A}$  and  $\mathbf{B}$  across the diagonal to the opposite corner of the parallelogram. If the vectors are perpendicular and unequal in magnitude, the parallelogram will be a rectangle. If the vectors are perpendicular and equal in magnitude, the parallelogram will be a square.

## Adding Vector Magnitudes

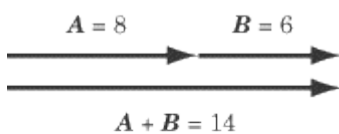
Of course, knowing what the sum of two vectors looks like is often not enough. Sometimes you'll need to know the magnitude of the resultant vector. This, of course, depends not only on the magnitude of the two vectors you're adding, but also on the angle between the two vectors.



### Adding Perpendicular Vectors

Suppose vector  $\mathbf{A}$  has a magnitude of 8, and vector  $\mathbf{B}$  is perpendicular to  $\mathbf{A}$  with a magnitude of 6. What is the magnitude of  $\mathbf{A} + \mathbf{B}$ ? Since vectors  $\mathbf{A}$  and  $\mathbf{B}$  are perpendicular, the triangle formed by  $\mathbf{A}$ ,  $\mathbf{B}$ , and  $\mathbf{A} + \mathbf{B}$  is a right triangle. We can use the Pythagorean Theorem to calculate the magnitude of  $\mathbf{A} + \mathbf{B}$ ,

which is  $\sqrt{8^2 + 6^2} = \sqrt{100} = 10$ .



### Adding Parallel Vectors

If the vectors you want to add are in the same direction, they can be added using simple arithmetic. For example, if you get in your car and drive eight miles east, stop for a break, and then drive six miles east, you will be  $8 + 6 = 14$  miles east of your origin. If you drive eight miles east and then six miles west, you will end up  $8 - 6 = 2$  miles east of your origin.

